

## **MOTIVATING UNDERGRADUATES IN SCIENCE AND TECHNOLOGY (MUST)**

Administered by the Hispanic College Fund, Inc.  
Type of Agreement: Cooperative Agreement

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All data provided in this update may be found in the November 2010 report by MPR Associates, "Motivating Undergraduates in Science and Technology: 2009 – 2010 Evaluation."

### **PROJECT DESCRIPTION**

The NASA Motivating Undergraduates in Science and Technology (MUST) Project is managed by NASA John H. Glenn Research Center at Lewis Field and administrated by the Hispanic College Fund (HCF). MUST is a multi-year initiative to develop undergraduate skill sets and expertise critical to the future STEM workforce and mission of NASA. It is the only undergraduate scholarship program at NASA that is dedicated to underserved and underrepresented students and is renewable through college graduation.

Number of students served annually:	100
Age group:	Undergraduates
Project focus:	All groups underserved in STEM

### **MUST Demographics for FY10**

The MUST team served a demographically diverse cohort in 2009-2010.

- By class year, 40 percent of MUST participants were juniors, 35 percent were sophomores, and 25 percent were freshmen.
- Eleven percent of students participating in MUST in the fall of 2009 were majoring in fields related specifically to space, such as Aerospace, Aeronautics, Astronautics, and Astronomy. Another 57 percent were studying Engineering not tied explicitly to space and an additional 32 percent were pursuing a Science or Mathematics major.
- Thirty-eight percent of these students indicated that they had participated in other NASA projects previously.
- Only 10 percent of students had earned a grade point average below 3.5. Fifty-two percent of participants earned GPAs between 3.5 and 4.0. Thirty-eight percent earned GPAs of 4.0 or higher. The median GPA was 3.9.
- 27% of students were the first in their family to attend college
- 25% of students attended a minority-serving institution
- The 100 students in the fall 2009 MUST cohort hailed from 23 states and Puerto Rico. The greatest number of MUST participants in the fall of 2009 was from Texas, Massachusetts, and California.

- When looking at student location by U.S. Census region, the greatest number of MUST participants in the fall of 2009 was from colleges and universities in the south. Within that census region, participants were most often enrolled at colleges and universities in the south Atlantic sub-region (NC, SC, GA, and FL)
- The fewest number of MUST participants was from colleges and universities in the Midwest. Within that census region, the west north central sub-region (ND, SD, MN, NE, IA, KS, and MO) had the least representation among MUST students.

## **PROJECT GOALS**

**GOAL ONE:** Support the development of science, technology, engineering, and mathematics (STEM) expertise leading to eventual degrees among groups that are currently underrepresented in the workforce, including women, minorities, persons with disabilities, and individuals from rural and low-income communities.

### PROJECT PERFORMANCE

- ~ MUST served a very diverse group of students in 2009–2010, though perhaps there was not enough representation of students with disabilities.
- ~ More than half of respondents indicated that MUST influenced their course selections.
- ~ All MUST students enrolled in at least one STEM course. Nearly all reported encountering exposure to a new concept or discipline in those classes.
- ~ The frequency of student-reported aspirations towards careers in STEM fields was high.
- ~ Students frequently mentioned that participation in research projects enhanced their understanding of content knowledge relevant to their coursework or areas of interest.

**GOAL TWO:** Provide support services such as tutoring and mentoring to ensure that students successfully complete their coursework and encourage degree completion.

### PROJECT PERFORMANCE

- ~ Most of the participants in MUST-sponsored tutoring indicated it was effective in helping them become more productive.
- ~ Almost all tutoring participants reported that their grades in relevant courses improved as a result of the tutoring and that the tutoring contributed to their success in completing the courses.
- ~ Most tutoring participants indicated the service helped them in their efforts to earn a degree in STEM.
- ~ The sense of belonging to a community was among the most frequently cited benefits of participation for MUST students.
- ~ How to excel academically, STEM-related research opportunities, and graduate study were among the most frequently reported topics students discussed with their mentors.
- ~ One of the most common student suggestions for improvement of the MUST program was to make mentors even more accessible.

- ~ Almost all new mentors indicated that they felt prepared for the mentorship after the orientation session.
- ~ Mentors feedback about the mentorship experience was overwhelmingly positive.

**GOAL THREE:** Provide hands-on research experiences that broaden interest in the aerospace industry.

**PROJECT PERFORMANCE**

- ~ More than half of participants had been involved in NASA research during the previous year. The remaining scholars were new to the project and not yet eligible for a NASA internship.
- ~ Students who had participated in NASA-sponsored research highlighted the value of the professional connections they made, the enhancement of their STEM content knowledge, and their access to conferences and other professional events and organizations.
- ~ Some variation in the rates of student participation in conference presentations by demographic characteristics and institutional affiliation was observed.

**GOAL FOUR:** Prepare students for a career in STEM by engaging them in holistic professional development experiences.

**PROJECT PERFORMANCE**

- ~ All but one student participated in a MUST-sponsored professional development event during the 2009–10 year.
- ~ Nearly all students attended the MUST Symposium. This event was cited as one of the most beneficial aspects of MUST participation.

**PROJECT BENEFITS TO OUTCOME 1:** Contribute to the development of the STEM workforce in disciplines needed to achieve NASA’s strategic goals, through a portfolio of investments.

The MUST project directly supports Outcome 1 of the NASA Education portfolio by contributing to the accomplishment of the following associated PART metrics:

- Number of underrepresented and underserved students participating in NASA education programs.
- Percentage of student participants employed by NASA, aerospace contractors, universities and other educational institutions.
- Percentage of undergraduate students who move on to advanced education in NASA related disciplines.
- Percentage of higher education program participants who have participated in NASA elementary or secondary programs.

**RESEARCH-BASED PROJECT MODEL**

MUST offers proven, intensive interventions for underrepresented and underserved students in STEM. The National Academies report *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (2010) found that successful college retention and workforce entry programs include research experiences, professional development activities, academic support, social integration and mentoring. *Expanding Underrepresented Minority Participation* also offers three additional recommendations for a successful national effort to increase the participation and success of underrepresented minorities in STEM. They include access and motivation, affordability, and academic and social support.

## PROJECT COMPONENTS

### *Access and Motivation*

#### **Individualized Student Support**

A dedicated team of two HCF staff members work on a personal level with each MUST Scholar to support them through college and the NASA MUST project by providing monthly follow up, updates on NASA education opportunities, and professional development and career awareness webinars.

#### **NASA Internship Experience**

MUST Scholars participate in a 10-week internship at one of NASA's ten nationwide centers. Scholars are matched with a mentor, receive an internship stipend of \$6,000, and complete a technical paper on their research and experience.

In 2009, the MUST team administered a formal survey to the mentor/supervisor of each MUST scholar who conducted an internship. 75.7 percent of respondents noted that their scholars professional and technical communication skills exceeded or significantly exceeded their expectations. 87.8 percent of mentor/supervisors agreed or strongly agreed that their intern was a good match for their project. In the areas of use of technology, conceptual/analytical ability, organization/planning, teamwork, leadership, work culture, and learning and applying knowledge, MUST scholars consistently ranked as "fully successful".

### *Affordability*

#### **Scholarships**

Project participants receive a scholarship to cover up to half of tuition and fees, not to exceed \$10,000 per year. The scholarship is renewable through college graduation provided that all eligibility criteria continue to be met.

### *Academic and Social Support*

#### **MUST Orientation and 21<sup>st</sup> Century Leadership Symposium**

MUST Scholars attend an annual Leadership Symposium where they participate in a project orientation, obtain professional development training, present their research, share experiences with their peers, and interview with NASA Center representatives for internship opportunities. The Motivating Undergraduates in Science and Technology 2009 Orientation and Leadership Symposium Evaluation Report prepared by UNCFSP

found that key findings from the multi-day symposium aligned with the following three objectives:

1. Providing students with an orientation into the NASA MUST Project.
  - 93 percent of scholars reported that the explanation of the NASA MUST Policies and Procedures Manual and Scholar expectations were good to excellent.
  - The majority of scholars (88 percent) reported having a good to excellent understanding of how NASA's Mission Statement is executed via the NASA Centers.
2. Providing students with the opportunity to meet with NASA field center representatives to learn about their specific research projects.
  - 98 percent of scholars said they learned new and valuable information during the center interviews.
  - Twenty-six scholars reported that they were considering interning at a center that they did not previously consider, as a result of the NASA Center presentations and interviews.
3. Delivering 21st Century Leadership Skills through workshops focused on Oral and Written Communications, Collaboration/Teamwork, Leadership, Lifelong Learning/Self Direction, Professionalism/Work Ethic and Personal Financial Responsibility.
  - These 21st Century Leadership Skills provided the overall structure for the symposium. Scholars found the training they received in Personal Financial Responsibility (87%) and Collaboration/ Teamwork (82%) to be the most valuable. Scholars also noted obtaining extremely valuable skills in Oral and Written Communications, Leadership, and Professionalism/Work Ethic (80%).
  - The following workshops received the highest rankings as definitely valuable:
    - 1) Dr. Howard G. Adams: "Maximizing Your Mentorship" (96%)
    - 2) Dr. Fred Higgs and Christopher Jones: "Mastering the Art of Proposal Writing" (93%)
    - 3) Dr. Fred Higgs and Christopher Jones: "Selling You: Resume Writing" (93%)
    - 4) Dr. Noe Lorzano: "Graduate School" (89%)
    - 5) Ryan Mack: "Money Matters" (87%)
    - 6) The Princeton Review: "Graduate Record Examination (GRE) Strategy Session" (85%)
    - 7) Dr. Eduardo Divo: "Building a Winning Team" (82%)

### **Mentorship and Tutoring**

Scholars are supported with tutoring and receive peer, graduate, and faculty mentors to ensure that they persist at a high level of academic performance and receive guidance in making the right post-graduation decision.

The MUST project has gauged its impact on Outcome 1 by gathering survey data related to each project component. An analysis of these surveys emphasizes the overwhelming success that MUST has had in its programming. As an example:

*Fall 2009 MUST End of Semester Survey Findings*

(n=99, number of responses varies by item. All percentages are based only on those who answered the question.)

**MENTORING:**

- Ninety-four percent of MUST scholars had at least one MUST mentor. Sixty-three percent had a faculty mentor, 53 percent had a graduate student mentor, and 32 percent had a peer mentor. Over one-third had the benefit of two or more mentors.
- Forty-seven percent of students with a faculty mentor communicated with that mentor for 2 or more hours a month. The same could be said of 29 percent of students with a graduate student mentor and 16 percent of students with a peer mentor.
- MUST students indicated that their relationships with their mentors were having a positive effect on their lives. In response to the prompt, “Because of my relationship with my mentor...” 86 percent agreed that they were people who would support them, 77 percent felt they had more options for their future, 70 percent had higher expectations of themselves, 64 percent had a better attitude toward school, 60 percent had better communication skills, 52 percent encountered new paths to careers not previously considered, 50 percent were more involved in STEM-related programs or activities, and 40 percent had better grades and test scores.
- Regardless of the kind of mentor students had, roughly one-third or more spoke with their mentor about STEM-related research opportunities, time management, and how to excel academically. With faculty and graduate student mentors, graduate school and career issues were also discussed. How to balance academics with a social life was a similarly common topic of conversation between students who had either a graduate student or peer mentor. One-third of MUST students paired with faculty mentors also spoke about STEM-related professional organizations.

**SEMESTER COURSEWORK AND EXPERIENCES**

- One-hundred percent of MUST scholars taking classes during the fall took a STEM course. Ninety-one percent enrolled in some type of natural science or math course and 56 percent participated in some kind of engineering course. Five percent took a course focused on space.
- MUST students were involved in a wealth of professional development activities. Ninety-four percent attended the MUST symposium. Resume building activities as well as leadership workshops were also popular with MUST students. 79

- percent participated in each of these activities. In all, 84 percent of MUST students participated in at least 3 professional development activities.
- MUST students largely agreed that they felt a part of the MUST community during the semester (71 percent). Over half agreed that participating in MUST influenced their course selections.

### 2009-10 MUST Student Tutoring Survey Findings

(n=6, number of responses varies by item)

- When asked what grade they received in the course for which they had tutoring, three of the respondents (50%) reported receiving a “B”. Of the remaining three respondents, one reported receiving an “A”, one a “C” and one failed.
- Five out of the six respondents indicated that their grades in the relevant course improved as a result of the tutoring. When asked how the tutoring helped, one respondent indicated s/he had found the tutor’s explanations of course content to be much more clear and concise than the course instructor, which helped his/her understanding of the material. Another respondent indicated that s/he was better prepared for tests as a result of the tutoring. And another indicated that the tutoring helped, but that it came along too late to really improve his/her grade.
- Five of the six respondents indicated that the tutoring contributed to their success in completing their STEM coursework. Among the four who explained their responses, one felt that the tutor helped him/her succeed in a major STEM class. Another indicated that specific instruction in differential equations helped them succeed. A third indicated that his/her tutor was there to help address problems as they arose and guide the respondent to the solutions. The one student who indicated the tutor did not contribute to his/her success explained that this was not the fault of the tutor.
- Two-thirds of the respondents indicated that their tutoring contributed to their success in completing a STEM degree.
- Half of the respondents reported that they had considered changing their major during the previous academic year. Two respondents explained their responses to this item. One indicated that the tutoring helped them complete a course for their STEM major. The other explained that the tutoring helped them realize that they could successfully master course material with extra time.
- Two-thirds of respondents indicated that tutoring helped them organize their time and be more productive. Two respondents explained why tutoring helped them in this way. One appreciated the dedicated time to study. The other explained that the tutor’s outline defined the material s/he needed to cover and helped them understand how different concepts related. One respondent who indicated that tutoring had not helped organize his/her time explained that s/he just had too much going on.
- When asked if they would have sought tutoring if MUST had not offered it, two-thirds of the respondents indicated in the affirmative. The two students who indicated they would NOT have sought tutoring explained that the cost would have been prohibitive.

- When asked if they would have met the 3.0 GPA minimum required for MUST participants without tutoring, half said they would have and half said they would not have.
- Two respondents offered suggestions for improving the tutoring program. One would have liked to find a tutor faster, and suggested sharing lists of past tutors and their contact information with students. Another respondent suggested offering students who attend institutions in areas with a higher cost of living a larger stipend for tutoring services.

## **PROJECT ACCOMPLISHMENTS**

### **SCHOLAR PARTICIPATION IN RESEARCH**

Just under half of MUST students reported in the fall that they had participated in NASA research *during the summer*. Another 15 percent reported pursuing NASA research *during the spring semester*. Not surprisingly, since they would have had more time to get involved, students further into the MUST Project and further into their undergraduate careers were more likely to have participated than their peers.

When asked if a NASA-supported research project resulted in specific accomplishments during the academic year, the most common response was that the project enhanced their professional connections through networking opportunities. Almost as frequently, students mentioned that the project enhanced their understanding of content knowledge relevant for their coursework or areas of interest. Several students indicated their summer projects were a means for them to present at conferences or were the bases for recognition by their schools or external organizations. A few also mentioned that the project led to additional research opportunities. Individual students reported that the project enhanced their academic performance, choice of courses, and confidence.

### **SCHOLARS WHO PRESENTED RESEARCH AT A CONFERENCE**

Nineteen percent of students presented at a professional or academic conference in the fall, and 15 percent did so during the spring. Juniors were much more likely to have done so than undergraduates. Students attending MSIs were more likely to have presented during both semesters. Even when controlling for race/ethnicity, first-generation college students and students attending MSIs were more likely to have presented at a conference.

### **PROFESSIONAL DEVELOPMENT EXPERIENCES**

All but one student in the fall and two students in the spring indicated that they participated in at least one professional development activity that academic year. During each semester, roughly one-quarter were in three activities and about half were in four or more. The most popular type of professional development activity students reported doing was the MUST symposium's professional development workshop. Ninety-six MUST scholars participated during the 2009–10 academic year. In addition the symposium was the second-most frequently cited response when students were asked about the most beneficial aspects of the MUST Project.



After the symposium, the two next most popular professional development activities were resume building and leadership workshops. About four-fifths of students reported participating in the fall, and roughly two-thirds reported participating in the spring. Another third or more worked on interview skills or attended a career fair. In the fall 14 percent went to a conference. In the spring 18 percent attended.

First-generation college students were more likely than their fellow MUST scholars to participate in five or more professional development activities. One hundred percent of first-generation college students attended the MUST symposium. First-generation students were also more than twice as likely to participate in a professional conference and more likely to attend a career fair and leadership workshop.

Students attending minority-serving institutions also did more career development work during the year than did other students. At least 95 percent of MSI students participated in three or more activities both semesters. For non-MSI students, that percentage was 66 percent in the spring and 80 percent in the fall. MSI students attended career fairs, worked on interview skills, and participated in leadership workshops at consistently higher rates than their fellow scholars.

When asked whether any accomplishments during the academic year were attributable to the MUST Project, participants most common response was that MUST contributed to their efforts to pursue and secure awards and positions in other programs relating to their academic and professional interests. In particular, several students mentioned that they collaborated on a successful proposal to conduct a microgravity experiment at NASA's facility in Houston. The next most common response was that MUST contributed to participants pursuit of leadership roles. Quite a few students also mentioned that the MUST eligibility requirements motivated them to challenge themselves to work hard and achieve to higher levels. A handful of students mentioned that MUST provided them with valuable networking opportunities.

### **IMPROVEMENTS IN THE PAST YEAR**

Close to 150 volunteers (including about 125 mentors) volunteered for MUST during the 2009-2010 academic year. The spirit of volunteerism and collaboration was also reflected in many of the scholars personal outreach efforts. Eleven MUST scholars nominated by NASA managers and mentors have become NASA Ambassadors since the Ambassador program started two years ago.

The NASA Johnson Space Center's Microgravity University also offered for the first time secure slots for two teams of MUST Scholars to participate in the 2010 Flight Week in Houston. Teams had to be made entirely of MUST Scholars. Several scholars submitted proposals and one team of four talented women successfully participated in the experimental flight program.

On an administrative level, the MUST project took giant leaps in the analysis and reporting of relevant student data. For the first time, the MUST project was evaluated by

an independent research firm.